KNOWLEDGE

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SCHOOLS (part two)

During the Middle Ages, education was mostly provided by monks

THE barbaric invasions which swept the territory of the Roman Empire from the 3rd century A D brought with them a great decline in education and culture. The rough and uncivilised barbarians scorned the principles of Christianity and lacked any appreciation of Roman or Greek culture.

Isolated monastic communities in many parts of Europe served to keep alive a love of learning. A few of them, like the celebrated abbey of St Gall which was under Irish influence, had schools for those both inside and outside their order.

In most monasteries, however, no attention was paid to learning at all, and such education as there was mainly concerned sacred subjects and was given to those young people who were eventually to become monks.

At the end of his education the son of a nobleman is made a knight

The age of chivalry

The coming of *chivalry* had a tremendous effect on people's lives during the Middle Ages, and many of its aims and ideals have lasted to the present day. The ideals included defence of the Christian faith and the protection of the weak and oppressed. Young men aspiring to become knights received mainly a military education, in the castle of a feudal lord. From the ages of 7 to 21 years they were instructed in the manners of a courtly gentleman and in the use of arms. Some account was taken of the need for intellectual education, but this was not thought to be of great importance. The court chaplain was entrusted with their religious education. At the age of 21 the young men became knights by means of a solemn religious ceremony. They had to swear to defend Christianity, to help the weak, and to be loyal to the ideals of chivalry.

The rise of the universities

The beginning of the 12th century saw a considerable increase in the number of schools attached to the larger cities and towns, owing to the popular demand for education by their inhabitants. Students came from far and near for instruction in those schools which had achieved a reputation for certain fields of advanced learning, and this type of school, over a period of years, came to be known as a university. The aim of the schools was at first to go more thoroughly into the subjects of *trivium* and the *quadrivium* (see Schools: part one). Later, other studies were added and grouped together to form various *faculties*. The main courses were: theology (Greek *theos*, god, and *logos*, study), law, medicine, and the arts. This last faculty included philosophy, literature, and science. Students who did well enough gained the title of 'doctor'.

The earliest and most important of the universities of the Middle Ages were those of Bologna, Paris, and Oxford. They served as models for the many which sprang up all over Europe during the centuries which followed.

The Renaissance

The name *Renaissance* (which is a French word meaning 'rebirth') is given to the revolt against the mediaeval outlook on learning and the desire, by the individual, to live a fuller life. To this end, the culture and learning of the earlier great civilisations were rediscovered. The works of Greek and Latin authors were studied once more, and art and architecture copied the styles of Greece and Rome. There was a revived interest in education; new types of schools were opened, and new programmes of teaching were experimented with, and adopted.

The Joyous House

Some brilliant educators opened their own schools to practise their new educational methods. One of these was *Vittorino da Feltre* (1378–1446), sometimes called the first modern schoolmaster. In this school could be found the perfect embodiment of the educational ideals of the Renaissance. After having taught at Padua and Venice he went to Mantua to be tutor to the sons of the Marquis Gian Francisco Gonzaga. In the grounds of the palace,

Previous page: Massimiliano Sforza's grammar lesson (from a 15th-century miniature)

KNOWLEDGE NEWS
Week beginning 5th May 1963

Could another race of monsters take over the earth?

BY far the most numerous beings on this earth are insects. About half a million species have been identified – there could be another three or four million which have yet to be classified.

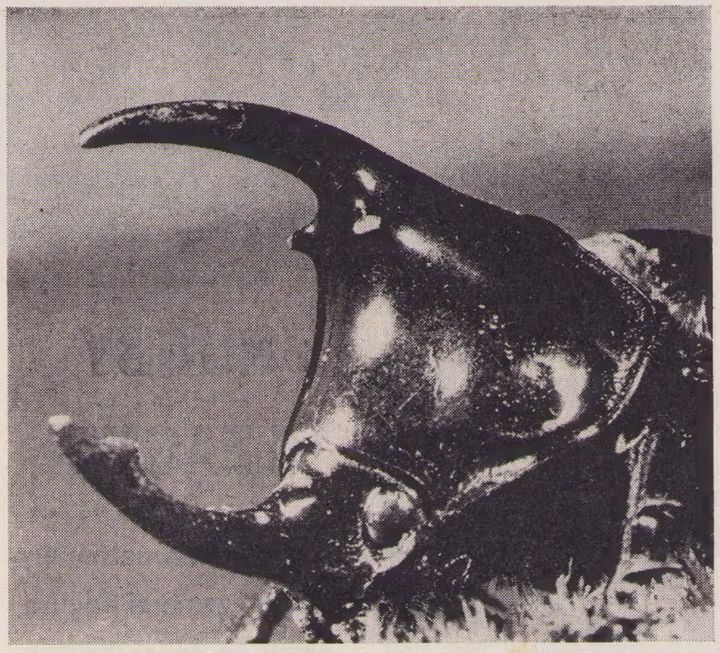
If you bought an ounce of fleas you would find yourself with some 80,000 of them. A really big tropical colony of ants might number about a million individual insects, and weigh as much as a man. In Britain alone 20,000 different species of insects have been identified.

Could these insects develop into science-fiction monsters and take over the earth? Could the tiny caterpillar grow into a lumbering, voracious brute swallowing bushes and flower beds with a single gulp? Could the wasp turn into a killer with a buzz like a Spitfire fighter, and a sting that could paralyse and kill in an instant? Could swarms of locusts roar overhead like squadrons of Flying Fortress bombers? The answer is no. The largest insect in the world does not weigh more than two or three ounces, and there are two excellent reasons why insects can never grow bigger.

The first concerns their way of breathing, which is quite different from ours.

Instead of having blood to carry oxygen to the tissues of their

[*continued in column 3*



A rhinoceros beetle – a lumbering monster, leaving a trail of devastation and death?

continued from column 1]

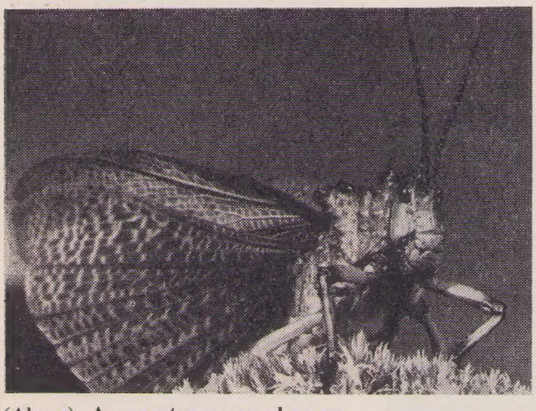
body, insects have a complicated tube system that takes the air direct to the individual cells. This can only work over a very short distance. If the tubes ever became as long as an inch, the system would become inefficient; at any length over that it would not work at all.

Secondly, insects have no body skeleton inside their tissues. Like crabs and lobsters, their skeletons are their skins – hard chitinous shells (chitin is a substance which forms the external covering of all insects). If insects grew as big as, say, cats, their internal organs, lacking the support of internal bones, would press down on each other with such weight that they would be squashed and could not function.

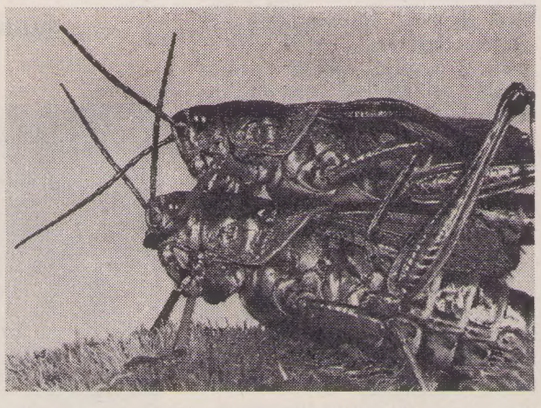
Supposing insects developed a different kind of breathing and a different kind of skeleton? Then they would not be insects at all, and their way of life would be different too.

It is possible, however, that insects could become the sole survivors on this planet. If mankind were stupid enough to plunge itself into a nuclear war, then insects might inherit the earth, for many of them are virtually immune to radiation.

Photos by Harry Miller



(Above) A monstrous grasshopper spreading its wings in fury to intimidate an attacker?



(Above right) Locusts like these flying overhead like squadrons of Flying Fortresses?

(Right) Could the snail turn into a gargantuan gastropod of the future – a murderous mollusc feared by humans? The answer is no. It has no skeleton to support its tissues, which would collapse if the snail grew beyond a certain size, although, unlike an insect, its method of breathing could still function if it were large.

The caterpillar – a voracious monster, devouring flower gardens and hedges?

Letter from the Editor

37 HERTFORD ST.
LONDON W.1

ONE of the most important developments in the 1950's and 1960's has been the tremendous growth of television. Nearly 30 million people watch it for up to two or three hours a day. As most people spend about eight hours either at work or at school, eight hours sleeping, and an average of about an hour travelling to and from work or school, this means that about one-third of their leisure time is spent watching television.

Is this a good thing or not? Television has been called the 'opium of the people'. It certainly can act as a drug. Sometimes it is quite difficult to turn the set off even though the programmes are trivial. People can watch television for a whole evening, hypnotised by the flickering screen. In the case of young people, this is certainly not desirable.

Moreover, on ITV a few of the advertisements might have a bad influence: by persuading young people that the most important things in life are to have lots of friends of the opposite sex, or to impress other people.

A Power for Good

On the other hand, television has a tremendously good effect. It has made people more aware of what is going on in the world and of the characters of the people who guide its destiny. Because it is a most vivid way of presenting information, it arouses people's interest in subjects that otherwise they would probably have not known about. In fact, since the popularisation of television, the standard of general knowledge has been raised considerably.

Television has also had a great political influence. Politics are not just confined to the world of Westminster. On television, politicians have to answer questions, often awkward ones, with half the nation looking on. Although this is definitely desirable, the fact that politicians *must* have a good television personality is not necessarily so.

As public opinion decides who rules the country, and as television helps to shape public opinion, so television has a tremendous influence in guiding the destiny of the nation.

John Chancellor

From England, Rugby League has spread to other countries. Here a Frenchman brings down a New Zealand forward in an international match at Paris.

RUGBY LEAGUE

The only internationally-played game of English origin in which Britain has never lost her dominance

RUGBY League football is becoming more popular than ever. This rough and tough game, in which the ball is carried as well as kicked, originated in the north of England.

The most obvious difference between Rugby League and Rugby Union is that the League men get paid for playing – they are professionals. It was this business of paying players that led to the split between the two codes in 1893.

During the 1880's and early 1890's Rugby football made great progress among the coal miners in northern England. But most of them could not afford to play unless they received compensation for working time lost.

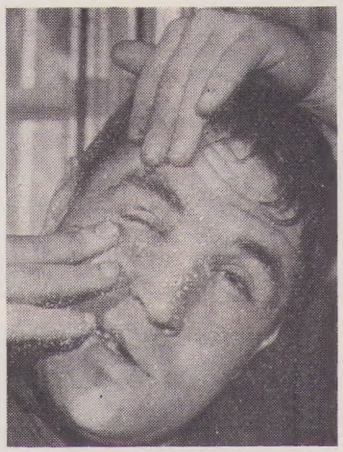
The Rugby Union people frowned on this, regarding it as the beginnings of professionalism, and eventually many northern clubs broke away from the Union on this issue.

They formed the professional Northern Rugby Union – later the Northern Rugby League.

However, the League is not professional in the same way as big-time soccer. All the players have full-time jobs outside football, and are only paid by the clubs for matches played during the season.

In the actual play, Rugby League differs from the Union code in that it is played by 13 men a side. This, the League fans claim, opens the game out and speeds it up.

League rules make it hard to gain ground by kicking for touch, and, because of this and other regulations, there are fewer stoppages than in Rugby Union, in which the ball is continually having to be put into play again.



Rugby League can be tough. John Shaw (above), the British hooker, was sent off the field for allegedly using a rabbit punch. But before this, Shaw claimed that he had been bitten over the eye, kneed in the stomach and battered in the face!

There are some 30 clubs in northern England in places like Wigan, Warrington, Huddersfield and Leeds, and there are also more than 500 junior (amateur) club teams – and about 60 school teams. Naturally the junior and school teams are NOT paid for playing.

The League code of rules has not spread so widely as the Union code – but Rugby League is played in Australia, New Zealand and France. England plays France both home and away each season, and also receives touring sides from New Zealand and Australia.

It is interesting to note that Rugby League is perhaps the only major sport in which Britain has never lost her dominance.

And it is equally interesting to think that the whole game of Rugby, both League and Union, stemmed from something which could only be called an accident.

In the early 19th century there were many kinds of 'football' in Britain. The rules, such as they were, called for one side to get the ball into the other's goal.

The numbers on each 'side' varied enormously. At Rugby School upwards of 100 players took part in a game. The rule was that the ball could only be moved by kicking it. During a match in 1823, a certain William Webb Ellis picked the ball up and ran with it. At the time it was called 'unfair practice' – but today a special tablet commemorates Ellis's action, for that is how Rugby football was born.

****

FEW people realise that the name 'pen-knife' really means a knife with which to cut pens. Working in their own homes, skilled people cut about 50,000 quill pens every year for a London firm. The firm sells batches of 250 to the Stationery Office. Many of these quill-pens are used for Admiralty charts. Quill pens are also used by lawyers preparing legal documents, and by artists for making the lettering on illuminated addresses.

When ships are lost at sea, Lloyd's, the great shipping insurance firm, always enter the names of casualties in the Casualty Book with a quill pen.

A Church document was once written with one quill pen only, and it contained 50,000 words. The best quills are those from a turkey or goose – sometimes swan feathers are used. Turkey feathers produce hard quills, goose feathers soft ones.

AUSTRALIA: flora and fauna

AT Babinda, on the northern coast of Australia, the best part of 160 inches of rain fall in a year. At Oodnadatta, in the middle of the continent, about 4 inches fall, 40 times less!

At Marble Bar, in the north-west, the average temperature in summer (that is January and February) is between 93°F and 95°F. At Canberra, in the south-east, the average summer temperature is from 60° to 70°F.

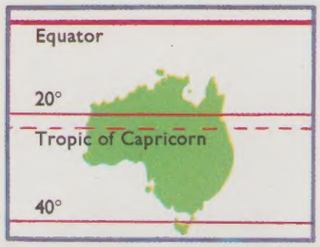
At some places in the interior the daytime temperature rises above 85°F, while in the night it falls to about 40°F, giving a difference (which meteorologists call an 'excursion') of about 45°!

This is Australia, the continent of contrasts – the continent where some regions are flooded for weeks, while a third of the country cannot be cultivated because its rainfall is always less than 10 inches a year; the continent where the temperature on the north-east coast never falls below 70°F, while at Melbourne, in the south-east, even in the summer season the winds from the Antarctic bring days of freezing cold.

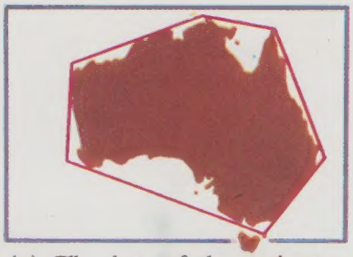
As we might expect, the flora and fauna show equally striking contrasts. In the north-east there is hot, humid forest very like the Malayan jungle. On the south coast the climate is cool and not unlike that of southern Europe, while the interior of the continent is largely hot, arid desert, inhabited by very specialised types of animals and plants.

THREE FUNDAMENTAL CAUSES

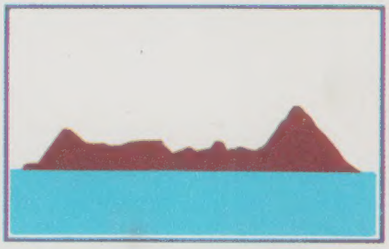
The extreme contrasts in climate and vegetation which are met with in Australia are caused mainly by three factors:



(1) *Australia's geographical position. As it extends from the hot equatorial zone to the cool temperate zone, its temperature decreases greatly from north to south*



(2) *The shape of the continent, which is compact, and without deep bays. Because of this, the central region of Australia is far from the sea and tends to have a 'continental' climate*



(3) *The 'saucer-shaped' formation of the continent, with its edges elevated. The mountains intercept the moist winds, so they cannot reach the interior, which is therefore very dry*

The animals

The fauna (animal life) of Australia is of enormous interest, because it is a sort of relic of what the animal life of the earth was like in former geological times. When the first European colonists arrived there, they found (with the exception of the dingo and a few kinds of rats and bats) mammals belonging only to primitive types – that is, the marsupials or pouched mammals, and the still more primitive monotremes, which actually lay eggs, just as the reptilian ancestors of mammals did millions of years ago.

The monotremes are found only in the Australian region (which includes New Guinea and Tasmania). They include the famous platypus and the echidnas or spiny ant-eaters.

The marsupials are not confined to Australia, a few being found in South and North America, but there is a far greater variety of them in Australia. Their chief peculiarity is that their young are born when they are still very small and undeveloped, and are then put in a pouch or *marsupium* on the mother's body, where they continue their development. The largest and best known of the marsupials are the kangaroos, but there are a great many other kinds. Many of these have an appearance and way of life similar to certain of the higher mammals of other regions. For example, the Tasmanian wolf or thylacine is very like a wolf, the dasyures are like cats, and the flying phalangers look just like flying squirrels.

The reason why the Australian fauna is so very distinct is that Australia was cut off

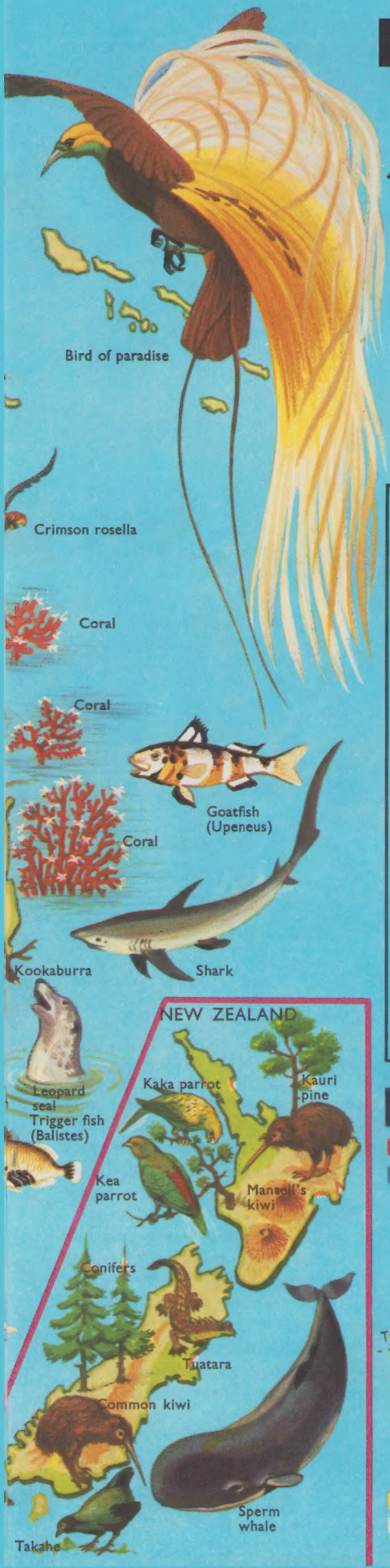
THREE TYPES OF AUSTRALIAN FLORA

Panoramic view of the eastern mountain chain (the Blue Mountains), with thick forest

View in semi-desert country with dwarf acacia trees and halophyte *(salt-loving) plants*

The fertile plains of the south-east coast, with pasture, crops, and abundant natural vegetation

Map of the flora and fauna of the Australian region. The animals are not drawn to a uniform scale.
Nipah palm
Tree kangaroo
Eucalyptus
Papuan cassowary
King of Saxony's bird of paradise
Hornbill
Lory
Frigate bird
Papuan wild boar
Crowned pigeon
Tern
Fan palm
Eucalyptus
Pandanus
Red-tailed tropic bird
Archduke Rudolph's bird of paradise
Bottle tree
Estuarine crocodile
Black-necked stork
Grey-headed albatross
Wild rabbit
Coconut palm
Black rock-wallaby
Dasyure
Dugong
Masked owl
Budgerigar
Rock-wallaby
Golden-shouldered parrot
Honey-eater
Australian cassowary
Moloch
Lyre bird
Honey-mouse
Flying phalanger
Dingo
Frilled lizard
Rabbit bandicoot
Satin bower bird
Emu
Wombat
Grass tree
Monitor lizard
Sea eagle
Rock-hopper penguin
Rat kangaroo
Opossum
Stump-tailed skink
Red-winged wren
White-backed magpie
Rosella parakeet
Echidna
Straw-necked ibis
Black swan
Brush turkey
Platypus
Koala
Cape Barren goose
Giant eucalyptus
Emu
Sea lion
Red kangaroo
Tasmanian devil
Thylacine
Gannet
1938



DIAGRAMMATIC PROFILE OF AUSTRALIA FROM WEST TO EAST

from the great central land mass of Asia many millions of years ago, before the higher mammals had developed. Throughout the rest of the world the marsupials were almost exterminated by competition with the higher mammals. Many other primitive animals, besides mammals, have survived in Australia for the same reason, and in New Zealand there are no native mammals except bats, but some extremely primitive birds, such as the kiwi.

The presence of native rats in Australia can be explained by supposing that they arrived there on drifting vegetation, while bats could fly in from Asia. The dingo was certainly brought to Australia by the aboriginal people many thousands of years ago.

It is a great pity that harmful animals like rabbits and foxes were introduced to Australia and New Zealand by European colonists.

FLORA OF AUSTRALIA

The vegetation of the Australian continent is largely related to its rainfall. As the diagram at the top of this page, and the map below explain, there is more rain near the coasts and progressively less as you go into the interior. The absence of coastal mountains to the west means that dry conditions in this region extend to the coast.

Along the north-east coast, from Cape York to Brisbane, there is a high temperature all the year round and, mainly in the summer, heavy rainfall. Here tropical rain forest grows, like that in Malaya, with lianes, tree-ferns, palms, and other trees, many of which are only found in Australia. These include species of *Araucaria*, similar to the monkey puzzle of South America, and the remarkable bottle tree (*Brachychiton rupestris*).

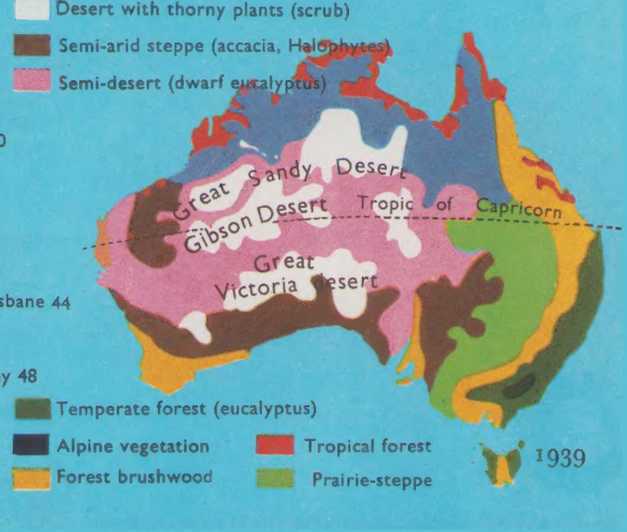
Farther south near the east coast is forest, dominated by the giant eucalypts or gum trees. These eucalyptus trees are the most characteristic feature of the Australian flora (plant life), and there are about 600 species of them, ranging from the 300-foot giants of the coast to the dwarf eucalypts which form the 'mallee scrub' of the dry interior.

The south-east and south-west coasts have a climate rather like that of the shores of the Mediterranean, though there can be sudden changes of temperature, caused by hot winds from the interior or very cold winds blowing from the Antarctic. Here there is moderate rainfall, mostly in winter (July and August), and most of the land is covered by open forest or bush. The dominant trees are eucalypts and wattles, which belong to the genus *Acacia*.

As the rainfall diminishes, going inland, the dwarf eucalypt and acacia scrub is replaced by desert. Where this is sandy, tufted grasses with sharp leaves are found, such as the porcupine grass and cane grass. Elsewhere there is a type of vegetation known as saltbush. Here the intense evaporation causes the soil to become impregnated with salt, and the only plants are *halophytes* – that is, plants specially adapted to grow in salty places.

MAP OF AUSTRALIA'S RAINFALL

DISTRIBUTION OF VEGETATION IN AUSTRALIA



EUROPE BEFORE THE 1914 – 1918 WAR

PRE-1914 Europe was a continent on the brink of catastrophe. On the surface little had changed. The appearance of new states like Italy and Germany had not threatened the existence of the Old Empires like those of Austria, Russia, and Great Britain. Europe had a familiar ring. It still had a place for its kings and queens, its Hapsburgs and Romanovs. Many Slavs, including Croats, Serbs, and Ruthenes, still lived under the rule of Austrian or Turkish masters. Yet this lack of change, this serenity and complacency which had been bred into the people who wandered down stately gas-lit streets or danced gay Strauss waltzes, was an illusion. For beneath the surface forces were at work which were to rip the Continent apart and plunge it into chaos from which it would emerge in a new and barely recognisable shape.

The 20th century opened with Europe divided into two armed camps, which were shortly to clash head-on in the First World War. On the one hand was the Triple Alliance of Germany, Austria, and Italy. On the other was the alliance between France and Russia. In 'splendid isolation' sat Great Britain, uncommitted to either side but perhaps favouring the German alliance. How Britain came to fight on the side of Russia and France is largely the story of the disastrous policy pursued by Germany in the coming years.

But what was pre-1914 Europe like? Analysis would show us that few of the nations were politically stable, and that the apparent lack of change was only skin-deep. The greatest disturbing factor was nationalism, for many races were ruled by alien countries: Slovaks by Austria, Poles by Russia. They longed to be free, and after the holocaust of the First World War were granted their freedom. In 1914 Poland, Yugoslavia, and Czechoslovakia did not exist. By 1920 they did.

THE BALKAN PROBLEM

Russia was the most backward of the great powers. She was still a land of peasants and poverty, ruled by the Romanov Tsar Nicholas II. But even Russia was not stable, and before the end of the war the revolution had taken place which was to shatter Tsarism and establish Communism. The rulers tried to distract the people from their terrible conditions by a vigorous foreign policy and military success. Russia's first venture was against Japan in 1904, but this ended in humiliating defeat, which had two results. Firstly, it made the clamour for the government to produce success more intense. And secondly it diverted Russia's attention away from the Far East as an area of conquest, and brought her eyes back to the Western world. This in itself was of tremendous significance, for, in a sense, European peace depended on a concentration of the powers on objects away from Europe instead of on the continental danger spots. Russia's new policy centred firmly on one such danger spot, the Balkans and Balkan neutralism. The bulk of the subject races belonged to the Slav group and Russia herself was the greatest Slav power. She therefore adopted a policy of encouraging the Slav races to revolt against their foreign masters and to become independent and, of course, under the influence of Russia. Balkan nationalism was at its fiercest in the desire of the Serbs (who were Slavs) to be united with the already independent Serbia. So that the Balkan pattern was of increasing Serbo-Austrian conflict, with Russia backing Serbia, and Germany backing her ally, Austria.

Tsar Nicholas II (1865–1918), *Emperor of Russia*

Political map of Europe in 1914.

FRANCE AND ITALY

France, Russia's ally, was economically among the most progressive nations, and was able to supply Russia with much-needed money loans. France, too, had an active foreign policy. Her fiery leader Clemenceau demanded revenge against Germany for the humiliating defeat she had received at German hands in 1871. Most important of all, Alsace and Lorraine had been ceded to Germany, and France demanded their return. So France's enmity with Germany, and Russian hostility to Austria, drove them together against the Austro-German Alliance.

years been a great power in Europe. She was ruled by the Emperor Franz Joseph who had been on the throne since 1848 – as long as most people could remember. However, her power was about to undergo a change in fortune, and she was to emerge from the First World War a third-rate and feeble nation. Austria ruled over many subject nationalities, all striving for independence. Serbia encouraged Austrian Serbs to revolt. Russia did the same. In 1908 Austria annexed Bosnia and Herzegovina, Slav countries whose annexation roused Serbia and Russia to a frenzy. War nearly broke out then, and was not long in coming: war which was to liberate all Austrian subject races. If no power was so traditional as Austria, none was more out of date.

THE NEW GERMANY

Germany was the crisis country of pre-1914 Europe. The German Empire, created only in 1871, was new, powerful, and ambitious. Her policy was in the hands of the military leaders, backed by the aggressive Kaiser Wilhelm II. The policy they evolved directly antagonised Great Britain; Germany built the Baghdad railway into the heart of the Turkish Empire, which seemed to threaten the British route to India, and a series of insults poured out against the British. Above all, Germany built a navy.

Britain at that time adopted what was known as the two-power naval standard: that is, her navy was to be as powerful as the next two strongest navies combined. German policy stated that the German navy must be as strong as any other. The result was a furious arms race. Hysteria against Germany mounted in Britain, and a book called *Made in Germany* alarmed British manufacturers by pointing out the incredible rate at which German industry was overtaking their own. Large crowds demanding more battleships gathered outside Mansion House, chanting: 'We want eight and we won't wait.'

Britain was driven into alliance with the powers hostile to Germany, and in 1904 the famous *Entente Cordiale* with France, which King Edward VII did so much to bring about, came into being. Russia naturally came into the British camp with her French ally, and the alignment which was to fight the First World War was complete.

Italy's policy, militant but ineffective, brought her into conflict with France who, like Italy, had colonial ambitions in North Africa. So Italy naturally ranged herself with Germany and Austria as the third member of this anti-French Triple Alliance, although when war broke out Italy remained neutral and eventually entered the war against her former allies.

STRIFE IN AUSTRIA

No power gave Europe greater solidarity than the Austro-Hungarian Empire. Austria had for

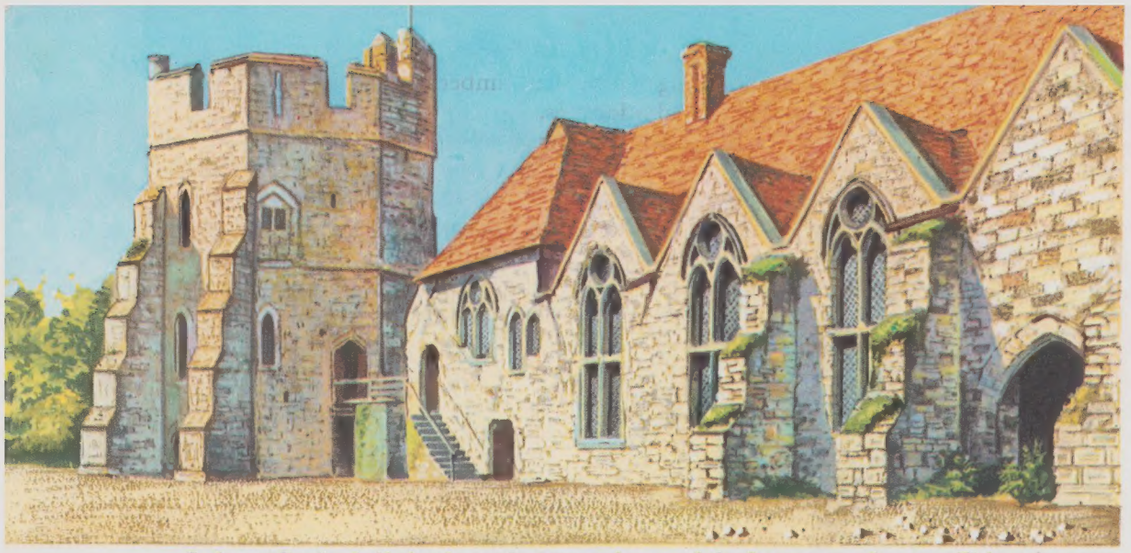
Kaiser Wilhelm II (1859–1941), Emperor of Germany

THE WAR

A world war does not have one cause, it has many. Russia fought Austria because of the Balkan question. France fought Germany because of the Alsace-Lorraine question. Britain fought Germany for very little reason and she fought Austria for none at all. Italy remained neutral because at this stage she could not tell which side would win.

Bismarck's Germany had avoided conflict with Britain by three simple rules: do not interfere with Constantinople nor with Belgium, and do not build a navy. All three were traditional tender spots with Britain, but Kaiser Wilhelm, with great foolhardiness, ignored the precepts of the wise old Chancellor. The Baghdad railway had threatened Constantinople, the navy had been built, and German armies on their way to attack France had marched through Belgium, which was the actual cause of Britain's entry into the war.

The war itself began between Austria and Serbia. A fanatical Serbian murdered the Archduke Ferdinand, heir to the Austrian throne, and Austrian reprisal was so severe that war was inevitable. The whole chain of alliance was brought in and the First World War had begun.



Stokesay Castle, built in the 13th century, is one of the finest manor houses still in existence

LORD AND MANOR

THE Western Region of British Railways has more steam engines with names than any other region; and of these a large majority are the Castles, Halls, Manors, and Granges designed between the two world wars by Mr C. B. Collett of the Great Western Railway. They carry the names of large houses, castles, and palaces; and they remind us how common large houses are, not only in the west of England but in every other part as well. If we looked at the buildings after which the engines are named, we should find houses of every period from the Middle Ages to the 19th century. In most cases, however, the name of the house is extremely old, and there has been a house on the site since the Middle Ages.

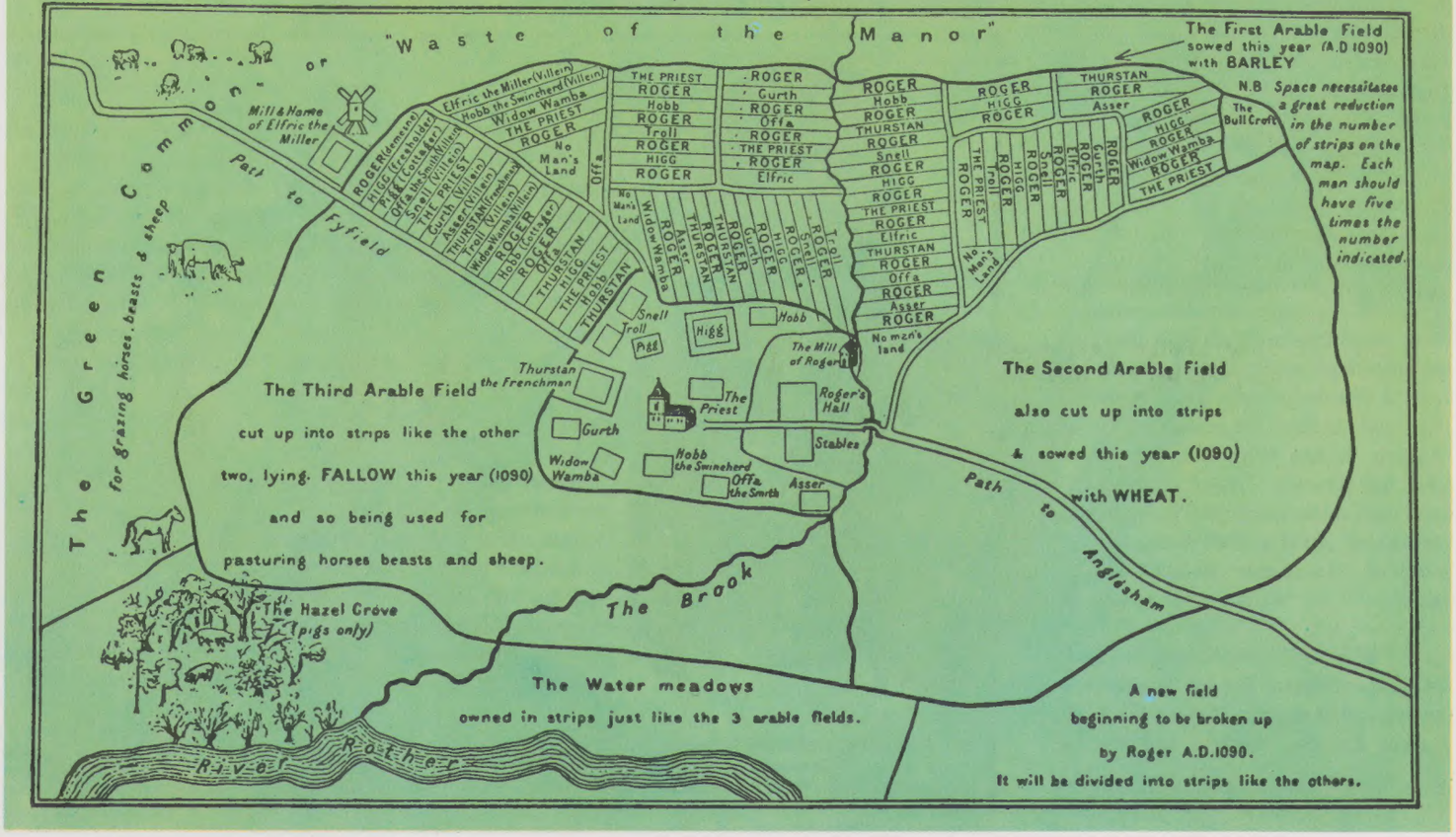
The mediaeval manor

What was a manor? When the Normans came to describe the England they had conquered and the estates they had won in Domesday Book (1086), they called each estate a *manerium*, a Latin word they made up (since Domesday Book was written in Latin) from the French word *manoir*. Our word manor also comes from this French word. *Manoir* was the French for 'hall', for men of the time expected to find a hall at the centre of every estate; and there was usually a strong building of wood or stone which was the lord's headquarters.

Sometimes the lord lived in the hall. If he was very rich and powerful, he was lord of many halls and lived in a strongly fortified castle. If the estate belonged to a monastery the 'lords' were the monks, living in their abbey. The headquarters of the outlying estates of some abbeys were called 'farms', or were given the French name, *granges*.

Thus castles, halls, manors, and granges represent the headquarters of estates in the Middle Ages, when lords were very powerful. Of these, the men of a village were most aware of the local house, the hall or manor. These words mean the same, but 'hall' is derived from an Old English (Anglo-Saxon) word, while 'manor' comes from the French term. The French origin of the word 'manor' reminds us that England after the Norman Conquest was ruled by the French-speaking Normans; the Old English origin of

This diagram of the 11th-century manor of Tubney shows how the land was divided into strips; it shows also how the crops were sown by rotation


"Waste of the Manor"
The Green Common
for grazing horses, beasts & sheep
Path to Fyfield
Mill & Home of Elfric the Miller
The First Arable Field sowed this year (A.D 1090) with BARLEY
N.B Space necessitates a great reduction in the number of strips on the map. Each man should have five times the number indicated.
The Bull Croft
No Man's Land
Offa
The Third Arable Field cut up into strips like the other two, lying FALLOW this year (1090) and so being used for pasturing horses beasts and sheep.
The Second Arable Field also cut up into strips & sowed this year (1090) with WHEAT.
Thurstan the Frenchman
The Priest
Roger's Hall
The Mill of Roger
Stables
Gurth
Widow Wamba
Hobb the Swineherd
Offa the Smith
Asser
Path to Aylesham
The Brook
The Hazel Grove (pigs only)
The Water meadows owned in strips just like the 3 arable fields.
A new field beginning to be broken up by Roger A.D.1090. It will be divided into strips like the others.
River Rother

the word 'hall' that lords and lordship existed long before the Norman Conquest.

The manors of the Middle Ages grew up in different parts of the English countryside in all sorts of different ways. The majority of the population were peasants, who lived by tilling the fields. Most of them were subject to the lord in some degree; but the degree differed greatly. It would be very confusing if we tried to enumerate all the varieties, but if we imagine that all estates or peasants were alike, we get a very dull and hopelessly wrong picture of life in the Middle Ages.

Ploughing and dividing the land

Over a large area in the Midlands and the south-east of England the soil is clay, often heavy clay, and the countryside is flat or rolling, without steep slopes or high hills. It is hard work to plough the soil, but it produces a good crop. So mediaeval lords and peasants devised a large and strong plough, and yoked a number of oxen or horses to it – three, four, perhaps even eight at a time – to pull it through the soil. It was easy for them to pull steadily and straight; the difficulty came when they turned a corner. So a type of field was deliberately designed in which the furrows were as long as possible – a large open field, such as was common all over northern Europe in the Middle Ages. The big plough was expensive, and the peasants had to band together to own one; they also had to share the large field between them. Everyone took a number of long, narrow strips – their shape dictated by the long furrows made by the plough – so that each man had his share of the produce.

In many parts of England one can still see fields with a corrugated surface, showing 'ridge and furrow' as it is called, that have lain under pasture since this method of ploughing went out of fashion in the 18th and 19th centuries. These ridges quite often show the outline of mediaeval strips.

During the early Middle Ages it was realised that crops grew better if there was some kind of rotation. Thus it was normal in the later Middle Ages for open fields to be divided into two or three. If there were two, one was cultivated each year, while the other was fallow (see page 1387), while if there were three, one was fallow, one was sown with wheat or rye, and one with barley, oats, or peas. Thus the crops went round from field to field in turn, in succeeding years.

How the manor was organised

It was in the Midlands and south-east, and in villages with large open fields, that one saw the sort of village shown on the facing page. Very often the whole village formed one estate, or manor. At its centre lay the manor house, where the lord might or might not live. Near it often lay the other chief building of the village, the church, which was usually even more imposing than the manor house. Not far away lay the village centre, a small group of streets with houses and gardens, sometimes with the village well and the village green in their midst. Outside the village centre lay the great fields, and other things vital to village life. There was the stream that supplied water and fish, and turned the wheels of the water-mill, where the peasants had to have their corn ground (and pay a fee to the lord as well as to the miller); and there were meadows for pasture, and woods and scrub which provided timber, firewood, and pasture for pigs.

A model of the type of plough used in England during the Middle Ages

In what ways were the peasants subject to the lord? They all paid rents of various kinds, and it was from rent that most lords earned most of their money. But many lords had their own farmland, their *demesne*, as it was called – either a separate plot or a number of strips among the peasants' strips in the open fields. This was partly tilled by hired labour, but largely by the labour of the peasants. A number of peasants were compelled to work on the lord's lands for a day or two a week, and more frequently at ploughing and harvest time. Some peasants had to work very hard for the lord and suffered other disabilities: they were called serfs or villeins.

The manor's place in the country

A village also had roads: narrow, often twisting round the edges of fields, with bad surfaces, but vital to the life of the village. They led to the nearest market town, where lord and peasant earned the money they needed by selling corn and everything else they grew or made. In Canterbury Cathedral lived a large community of monks. They had to be fed and clothed, and from their many manors in Kent and neighbouring counties came wagonloads and shiploads of corn and meat for the table, or wool for their 'habits', or beeswax for the candles in the cathedral. The life of the manor was not entirely isolated: it was part of the life of the whole country.

Canterbury Cathedral, part of which was built during the 11th century by Lanfranc, first Norman archbishop. The first building proved insufficient for devotional needs and for the accommodation of the monks of Lanfranc's priory

TOSCANELLI'S MAP OF THE WORLD

IT is hard for us to realise today how little the men of the Middle Ages knew about the planet they lived on. If science has advanced more than any other subject since the Middle Ages, geography must run it a close second. In 1450 many people believed the world was flat. They thought that the sun travelled round the earth, and that unexplored regions were strange lands of flying carpets and dragons.

The decisive advance in geography came in 1492, when Christopher Columbus, sailing west, 'discovered' America. The fact that he thought he had reached China does not lessen his achievement. Maps and distances could now be charted with far greater accuracy.

It was no accident that Columbus's voyage right at the end of the 15th century was followed by the great voyages of the 16th century, by such men as Marco Polo, John Cabot, Ferdinand Magellan, and Sir Francis Drake. Toscanelli's map drawn in 1457 shows what the world was thought to look like in Columbus's time. A copy of the map was sent to Columbus in 1481, and it was largely because of the deceptively small ocean Toscanelli had placed between Europe and China that Columbus undertook his momentous expedition.

This is a reproduction of the map of the world drawn by Paul del Pozzo Toscanelli in 1457. The original version of this map is now in a library (the Biblioteca Nazionale) in Florence

INACCURACIES OF THE MAP

In comparison with the maps we are used to today, Toscanelli's map looks very clumsily drawn. It is hard to believe that it was the work of a leading geographer. The shapes of some of the countries on the map are most peculiar. The Americas are the most obvious of the omissions, but Australia, New Zealand, the Arctic, and the Antarctic are all left out too. The general plan is simple, being merely one huge mass of land lapped on all sides by the sea. Africa is an absurd shape, and as we travel east places become even more unrecognisable. The only accurate area is the Mediterranean, and geographers have been getting that right since long before the time of Christ. Even Britain and Ireland are hopelessly inaccurate. In an age when there were many great artists, philosophers, and poets at fine universities, the lack of geographical knowledge was astounding. Methods of travel made little progress, and over many centuries almost no new information about distant parts of the world had been obtained. The Greek historian Herodotus, who lived in the 5th century B C, knew almost as much as Toscanelli.

The original of this map is 33 inches long and 16 inches wide. You will notice that two scales are drawn in the outer right-hand corners. The writing above the higher one reads *pro C miliaribus*, which means that each of the 13 spaces on the scale represents 100 miles. The lower one reads *pro L miliaribus*, which means that each of the 26 spaces represents 50 miles.

The reddish scroll drawn in the far left-hand corner of the map is the inscription known as the *legend*. This was the place where the author of the chart wrote its title. It has been translated from Latin by the Italian scholar Sebastiano Cino who made the original discovery of Toscanelli's map in 1941. It reads:

'This is a true description made in accordance with the views of several cosmographers and it

agrees with the opinion of Marino.' 'Marino' evidently refers to the famous mediaeval geographer and traveller Marino Sanudo.

Signor Cino has translated the rest of the inscriptions, and here are some of those on the many scrolls that decorate the map.

① 'This sea is called Ocean. They say that on all sides there is land except that part where begins the bay drawn here . . .'

② 'About Ireland they say that in it is an abyss called the Well of Saint Patrick, down which one descends to the Infernal Regions.'

③ 'From these mountains springs the Nile, and in the summer through the melting of the snows it runs much swollen.'

④ 'The Indian Sea is filled with many islands and rocks. For this reason their boats are built with many compartments in the middle. If one is broken in any part, the other parts prevent it from sinking.'

⑤ 'The Isle of Ceylon is renowned for its rubies, sapphires, and cats' eyes.' ('Cats' eyes' probably mean quartz.)

⑥ 'The mouth of the Ganges, whose breadth is 15 miles, has on its banks reeds so big that they impede the view.'

⑦ 'Over this region, which is named Cathay, or in their own language Cambalec, rules the Great Khan.' (Cathay was the mediaeval name for China.)

⑧ 'These islands are called Java.' (It is likely that he meant Japan – and that these were the islands which Columbus thought he had reached when he arrived at what are now called Cuba and Hispaniola.)

LATER EXPLORERS

Mediaeval exploration was haunted by two mistaken beliefs, both of which are apparent from Toscanelli's map. One was that from Europe there was a North-west Passage to the coast of Asia. The second was that there was also a North-east Passage to Asia. Seeking the first route, John Cabot in 1498 reached Baffin Land in the Arctic Circle, but, thinking he had reached Asia, moved south past the Hudson river in search of Japan! His son Sebastian organised an expedition to find the second route in 1553, which, in ignorance of the existence of the Arctic, was to sail north-east to the coast of Asia. On a disastrous voyage only one ship survived, and its occupants travelled overland to Moscow.

PI (part one)

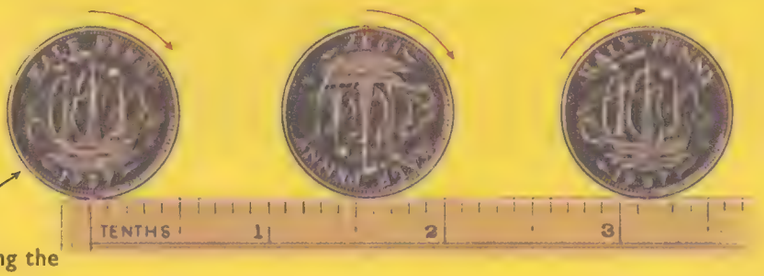
String
Diameter
Circumference

IF you take a piece of string equal in length to the diameter of a circular tin and wrap it round the side, you will find that the circumference is just over three times this length. Try it for yourself with different sized tins, and you will find that this is always so.

The ratio of the circumference to the diameter is, therefore, just over 3. But how much bigger than 3 is the ratio? What is the exact value? One way to find out is to measure the circumferences and diameters of several different circles, and then calculate this ratio in each case.

A flexible tape-measure enables us to measure the circumference of the tin as well as its diameter.

circumference = 22″
diameter = 7″
$\frac{\text{circumference}}{\text{diameter}} = \frac{22}{7} = 3{\cdot}14$ (approximately)

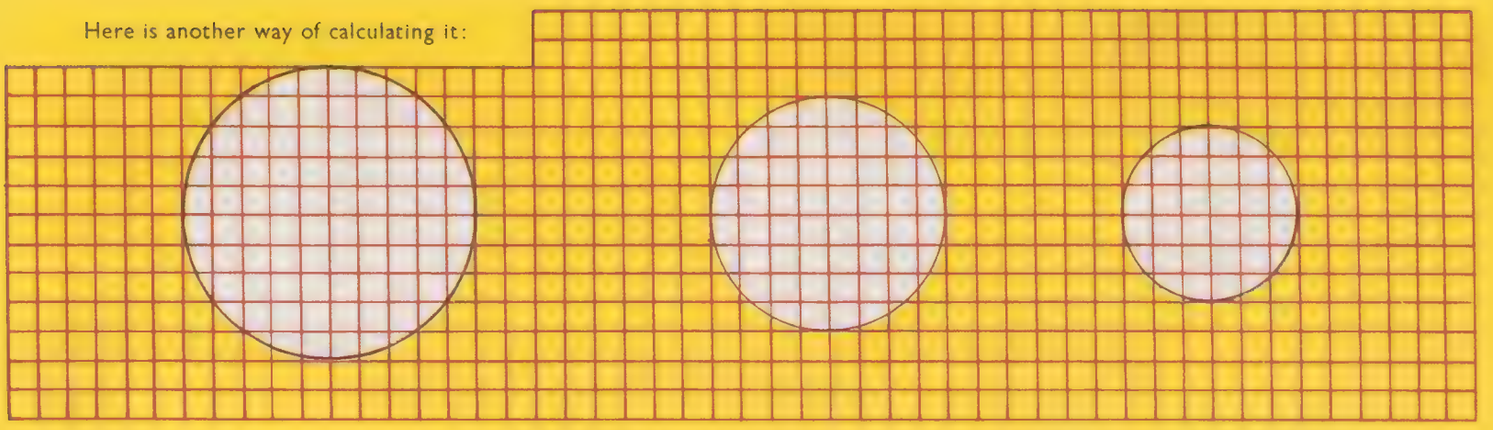


If we roll a halfpenny along the edge of one side of a ruler, we can measure its circumference.

Try this for yourself with other coins and circular tins.

circumference = 3·15″
diameter = 1″
$\frac{\text{circumference}}{\text{diameter}} = 3{\cdot}15$ (approximately)

Here is another way of calculating it:



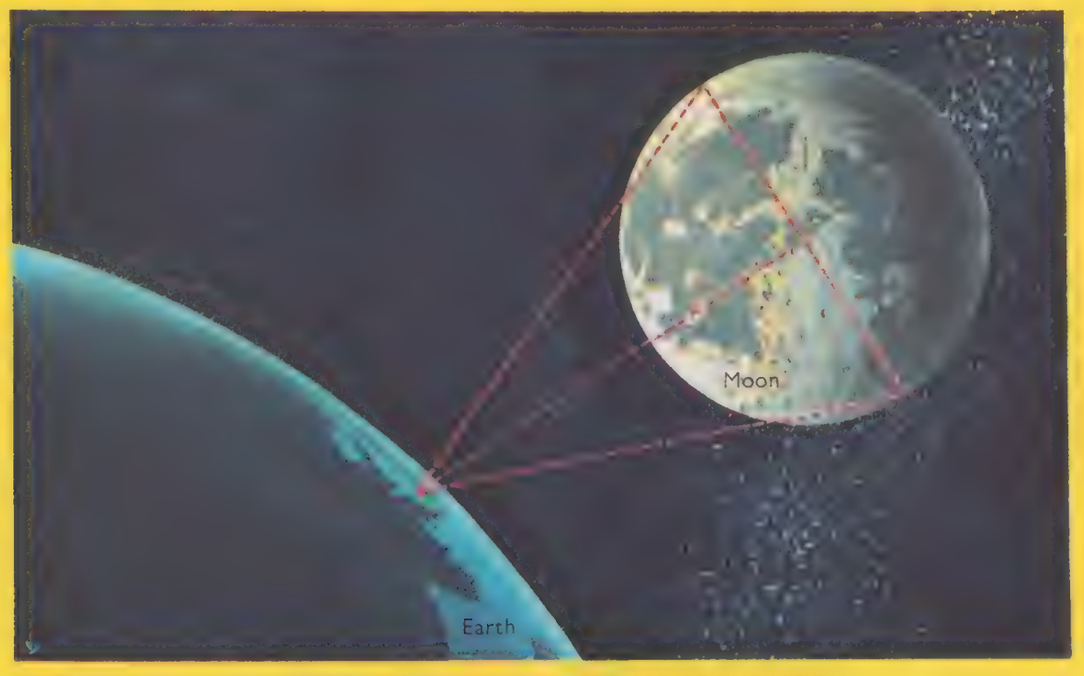
	Circle 1	*Circle 2*	*Circle 3*
diameter	10 units	8 units	6 units
circumference	31·4 units	24·9 units	19 units
$\frac{\text{circumference}}{\text{diameter}}$	3·14	3·11	3·17

Slightly different ratios have in fact been obtained each time, but it seems that if we had been absolutely accurate in our measurements, the answers would have been exactly the same. The average of our results, that is, 3·14, would probably be nearest to the true value.

Since the exact value of this ratio cannot be expressed easily, the symbol π is used to denote it. As we have seen, it is approximately 3·14. Another approximation that is used is $\frac{22}{7}$. The symbol π was first used by an Englishman, William Jones, in 1706.

So we can see that for all circles, no matter what their size, the circumference divided by the diameter equals π, or, written in short, $\frac{c}{d}=\pi$ (c and d stand for the number of units in the circumference and the diameter respectively).

Sometimes the same result is expressed as $c=\pi d$, or, since the diameter equals twice the radius ($d=2r$), it is expressed $c=2\pi r$. If we know the radius of a circle, we can calculate its circumference with the help of this formula.



CALCULATING THE CIRCUMFERENCE OF THE MOON

Through astronomical measurements and calculations, the radius of the moon has been established as approximately 1,080 miles. Although we cannot directly measure what the moon's circumference is, we can work it out.

Using the formula $c=2\pi r$

$$c=2\times\frac{22}{7}\times 1080 \qquad \text{therefore } c=6788\tfrac{4}{7}.$$

Thus we can calculate that the circumference of the moon is approximately 6,789 miles.

BEETLES (part two)

IN 'Beetles: part one' (pages 1931–1933) we described the subdivision called the Adephaga, which are nearly all carnivorous. We now come to the Polyphaga, which have very diverse appetites and include every other kind of beetle. The Polyphaga are far more numerous and far more varied than the Adephaga. In size they range from the huge Hercules and Goliath beetles to insects which you can hardly see without a microscope. Most of them are plant feeders, living on leaves or flowers or seeds, or even burrowing in solid wood; many of these confine themselves to one particular kind of plant. Some feed only on the dung of animals, others bury the bodies of small animals that have died, and a few of them are hunters of other insects.

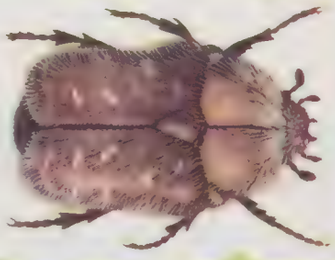
The great majority of them are harmless, and have no effect of any kind on the life of man. A few, that feed on the plants that we cultivate, or on our stores of food and other materials, are harmful. Others, like the ladybirds, are useful because they destroy great numbers of insects that are themselves pests. Others again are pretty, charming creatures like the little glow-worm that lights its tiny, greenish lamp in country lanes in the summer.

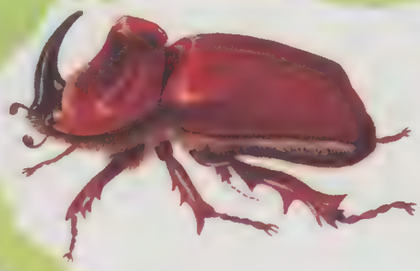
ROSE CHAFER (*Cetonia aurata*). This beautiful, shining green beetle is found in Britain, but is not very common. It feeds on the petals of roses and other flowers.

LADYBIRD (*Coccinella septempunctata*). Both the larvae and adults of these little beetles feed on aphids or greenfly, and so they are among the most useful of insects. The adult beetles hibernate through the winter.

HERCULES BEETLE (*Dynastes hercules*). This is one of the largest beetles and a native of tropical America. It can be as much as 8 inches long. The fierce-looking horns are used in combat between the males at mating time.

HAIRY CETONIA (*Tropinota hirta*). This curious beetle, with a coat of hair all over its body, is common in gardens in continental Europe. It is not found in Britain.





RHINOCEROS BEETLE (*Oryctes nasicornis*). This beetle obviously takes both its English and Latin names from the horn on its 'nose'. It is found in southern Europe, and grows to about an inch and a half long.

COCKCHAFER (*Melolontha melolontha*). This very destructive insect is unusual in being harmful both as a larva and as an adult beetle. Its life as a larva lasts for several years and is spent underground, where it feeds on the roots of various plants, including grasses and cereals. The beetle emerges in May (it is sometimes called the 'May-bug') and feeds on the foliage of trees.

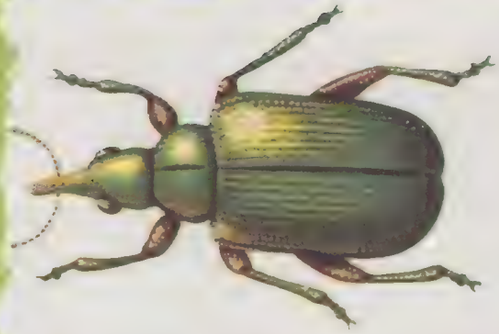
SACRED SCARAB (*Ateuchus sacer*). This beetle, which was regarded as sacred by the Ancient Egyptians, lives on the dung of animals. It makes large balls of dung, which it rolls about and stores underground for its young.

FURNITURE BEETLE (*Anobium punctatum*). This and the larger death-watch beetle are the insects responsible for 'wood-worm' in furniture and the structural timber of houses. It is the larvae, not the beetles themselves, which burrow in the wood, which may eventually become so honeycombed that it collapses. Little holes are formed in the surface where the beetles emerge, and these are the best evidence of their presence.

The beetles illustrated in this article are not drawn to scale

GRAIN WEEVIL (*Calendra granaria*). This and the closely allied rice weevil are serious pests of stored grain. The damage is done by the larvae, which may also infest biscuits and other kinds of food made from flour, if they are kept for a long time.

COLORADO BEETLE (*Leptinotarsa decemlineata*). Like the plant it feeds on, this notorious pest of the potato is a native of North America.



LEAF-ROLLER WEEVIL (*Byctiscus betulae*). The long beak or rostrum (seen also in the nut weevil) is characteristic of the weevil family, Curculionidae. This species lives on hazel; the female rolls up the leaves as a protection for her eggs.

PEA BEETLE (*Bruchus pisorum*). The larvae of this and allied species live in the seeds of peas and beans, both growing and stored, and do a great deal of damage. They are often incorrectly called 'pea weevils'.

FLOUR BEETLE (*Tenebrio molitor*). This is a serious pest of flour and other stored foods, but its larvae, called 'mealworms', are very useful as food for cage-birds and fish kept in aquariums.

LILY BEETLE (*Lilioceris lilii*). In Britain this species is found only in Surrey, where it feeds on lilies growing in gardens.

STAG BEETLE (*Lucanus cervus*). This is the largest beetle found in Britain, occurring only in the south of England, however. Males are about 2½ inches long, including the huge mandibles; females are much smaller and their mandibles are quite short, but far more efficient for biting than those of the male. The larva lives about three years in old decaying stumps of oak trees.

GREEN TORTOISE BEETLE (*Cassida viridis*). This very pretty beetle is fairly common in marshy places in Britain. Some of the tropical tortoise beetles are brilliant, shining gold, but this fades completely after death.

NUT WEEVIL (*Balaninus nucum*). This beetle lays its eggs in hazel nuts, using its long beak to bore a hole in the shell. The little white grub that you find when you crack a 'bad nut' is its larva. The beak or rostrum is characteristic of the weevils.

GLOW-WORM (*Lampyris noctiluca*). This is a carnivorous member of the Polyphaga and it feeds entirely on snails. The light which it produces is remarkably efficient, in the sense that it is accompanied by practically no heat, and so no consequent waste of energy. The male is winged and obviously a beetle, but the female (shown here) is a wingless, crawling insect, which has led to the name 'glow-worm'.

CLASSIFICATION OF THE COLEOPTERA

sub-orders: Adephaga and Polyphaga
order: Coleoptera (beetles)
class: Insecta
phylum: Arthropoda

Fluorine, chlorine, bromine, and iodine

Galleries in a rock-salt mine. Salt is the chief source of chlorine compounds

ONE of the properties of the periodic table of elements is that elements falling under one another in the same group have similar chemical properties. Four elements – fluorine, chlorine, bromine, and iodine – form group seven of the periodic table and are called the *halogens*. All the halogens are monovalent, and all combine with metals to form salts, and with hydrogen to form acids. All are very *reactive* – that is, they combine very readily with other elements.

Although they are similar chemically, the halogens differ from one another in their physical properties, which change in a regular way as one passes from one element to the next. Fluorine is a gas which boils at −187°C; chlorine is also a gas but with a higher boiling point, −34·6°C. Bromine is a liquid which boils at 58·8°C, and iodine is a solid which boils at 184·4°C. Similarly, the melting points of these elements rise steadily as one passes from fluorine through chlorine and bromine to iodine – that is, from a lower to a higher atomic weight. This gradation of physical properties is typical of elements in the same group of the periodic table.

Recently a new halogen, astatine, has been obtained in the laboratory. It does not occur in nature as it is radioactive and unstable. The chemical properties of this new element, which falls below iodine, are typical of a halogen. Its physical properties, so far as they are known, are as we expect them to be, judging by the properties of the other halogens.

FLUORINE

Symbol:	F
Atomic number:	9
Atomic weight:	19
Melting point:	−223°C
Boiling point:	−187°C

Fluorine is a yellow, very poisonous and reactive gas. It combines directly in the cold with most other elements. It was isolated by Moissan in 1886.

OCCURRENCE. Fluorine is far too reactive ever to occur free in nature. Its chief sources are fluorspar (CaF_2) and cryolite (Na_3AlF_6). The element is obtained by the electrolysis of a mixture of potassium fluoride and hydrogen fluoride.

USES. Until recently the only important use of a fluorine compound was that of hydrofluoric acid for etching glass. In recent years fluorine has been used in the preparation of very *inert* (highly resistant to attack by chemicals) plastics such as polytetrafluoroethylene (PTFE). It has also been used in the manufacture of new anaesthetics which are non-inflammable and safe in use.

CHLORINE

Symbol:	Cl
Atomic number:	17
Atomic weight:	35·5
Melting point:	−101·6°C
Boiling point:	−34·6°C

Chlorine is a greenish-yellow gas first prepared by Scheele in 1774. It is poisonous and very reactive. Davy showed it to be an element in 1810.

OCCURRENCE. Chlorine, like the other halogens, does not occur free in nature. Its compounds are numerous and widespread, the most common being salt (sodium chloride). The gas is made industrially by the electrolysis of sea water.

USES. Chlorine gas is used for bleaching textile fabrics, and it is a very important raw material for the chemical industry. It is used in the preparation of dyes, plastics, solvents, and synthetic rubbers. A lot of chlorine is used for the sterilisation of water to make it safe to drink. A few parts per million of chlorine in water will kill all dangerous bacteria.

BROMINE

Symbol:	Br
Atomic number:	35
Atomic weight:	79·9
Melting point:	−7·2°C
Boiling point:	58·8°C

Bromine is a dense red liquid with an irritant odour, and is liquid at room temperatures. Bromine was discovered by Balard in 1826.

OCCURRENCE. Bromine is only found combined with other elements. Its salts, bromides, are present in sea water in small amounts and the element is obtained from this source.

USES. Bromine is used in the chemical industry for the preparation of many dyes and drugs. Some is used to make silver bromide, a light-sensitive salt which is used in the manufacture of photographic emulsions.

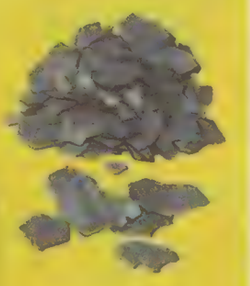
IODINE

Symbol:	I
Atomic number:	53
Atomic weight:	127
Melting point:	113·5°C
Boiling point:	184·4°C

Iodine is a greyish-black, lustrous solid which vaporises to give an irritant violent vapour. It is less reactive than the other halogens. Iodine was discovered in 1811.

OCCURRENCE. Compounds of iodine are widely distributed in sea water and in underground brines.

USES. Iodine is used as an antiseptic. It is also used in photographic and chemical industries.



Crystals of iodine

THE PLANETARIUM

The audience looking at the night sky in the planetarium. On the left is the moon, which looks oval in the illustration because the ceiling is curved. The narrator's arrow is pointing to the planet Mars

IF you were lost at night, could you find your way home by the stars? Can you tell what time of year it is by looking at the night sky? Have you ever seen an eclipse of the sun, a shower of meteorites, or the aurora borealis? A planetarium is a place where you can see all these wonders and have them explained to you.

For many, many years men have used the stars to guide their journeys on land and sea. Certain star groupings, called *constellations*, have been given names. In the northern sky one of the best known of these groups is the Great Bear. In the southern sky, the Southern Cross is just as familiar. Men have drawn maps of the sky, and have made models to show the movements of the planets, but these were all very simple.

Then, about 40 years ago, an instrument was invented which projected a complete picture of the heavens on to a domed ceiling. For the very first time it was possible to follow the movements of all the planets among all the stars that can normally be seen on a clear night with the naked eye.

The man who designed the first 'universal projector', as it is called, was Dr Bauersfeld of the famous optical firm of Zeiss.

The projector consists of two globes linked by a lattice-work cylinder. It contains about 29,000 individual parts, 230 ball bearings, and nearly 200 optical projectors. The whole instrument weighs over two tons.

One globe, or 'star carrier', projects the stars of the northern hemisphere, the other the southern. Between them, they project about 8,900 stars. In the lattice cylinder are projectors for the Sun, the Moon, the five planets that can be seen without a telescope, and the Earth.

The instrument can be moved in three different ways by means of special gears. It can be rotated to imitate the rotation of the Earth, and it can be made to imitate what is known as the *precession of the equinoxes*, or the circle that the Earth's axis is making among the stars. This takes 25,800 years to complete, but in the planetarium it can be seen in a matter of minutes.

The third movement enables either of the two 'star carriers' to be used, showing either the northern or the southern sky.

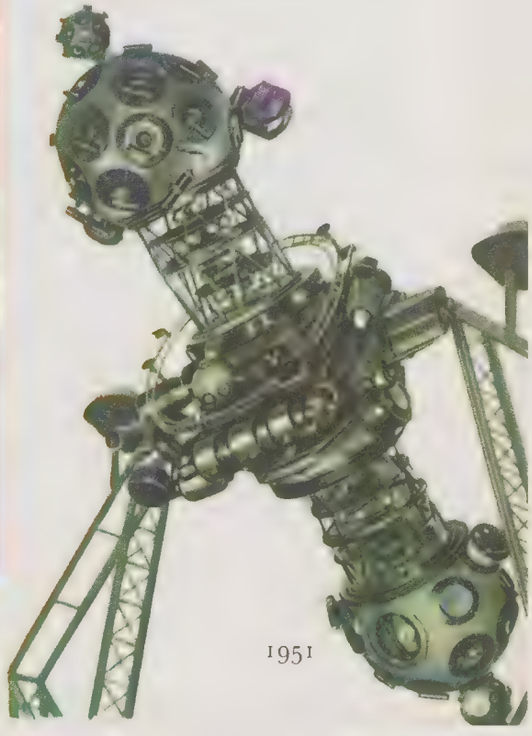
Let's imagine that you are inside the planetarium and have taken your seat. The lights dim very slowly, and as they do, the shining domed ceiling over your head gradually disappears. The stars grow in brightness in the darkening sky, and soon the whole wide sweep of the heavens can be seen. Now the voice of the narrator is heard: he will guide your eyes to the familiar and unfamiliar stars over your head. Perhaps he will show you what the sky must have looked like when Galileo first looked through his telescope in 1610 (see page 625), or what you might see if you lived in another part of the world. He may point out the different constellations, or send a shower of shooting stars across the sky. You will learn to recognise the planets – Mars, Jupiter, Saturn, Mercury, and Venus – and see how they move about the Sun. Perhaps you will be taken right out into space, to a point far beyond Saturn's orbit, from where you will be able to see our own planet Earth, moving on its course with the other planets. Then, back on Earth once more, Venus, the morning star, appears in the east. The light grows stronger, and you are under the shining dome again: your journey into space is over.

THE LONDON PLANETARIUM is one of the largest in the world. Certain very difficult problems had to be overcome when it was being designed. For one thing, the underground railway runs just below the surface: vibrations sent up by passing trains have been avoided by making the building weigh more than 2,000 tons.

Another problem was how to shut out London's noise. This was solved by covering the inner dome with a huge 'eiderdown' of sound-absorbing material. Over this is a 3-inch-thick concrete dome which is separated from another similar dome by a 3-inch air-space filled with fibre-glass. This second concrete dome is covered with cork, and over that again is a layer of felt. The final layer is thin copper sheeting.

Dirt and dust from the big city also had to be kept out if the planetarium was to be a success, for they could destroy the clarity of the many thousands of tiny beams of light representing the stars. The air in the auditorium (where the visitors sit) is therefore filtered so that it is changed eight times an hour. Pressure is kept at 2 lb a square inch higher than outside. This also helps to keep out dust.

The 'universal projector' in the planetarium. One globe projects stars of the northern sky, the other the southern. Between them they can project about 8,900 *stars*



LINCOLNSHIRE

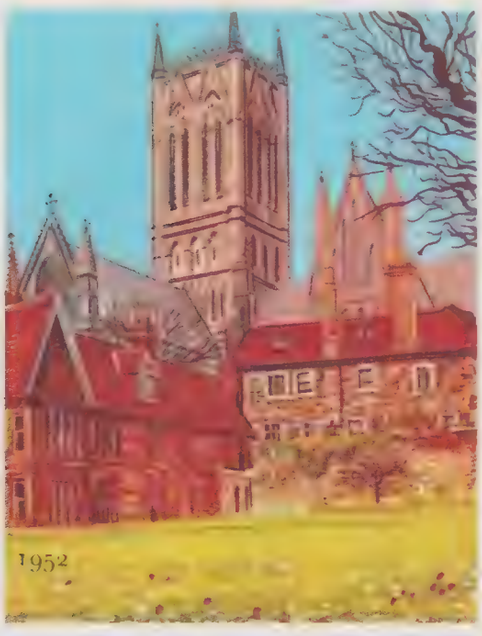
Flat countryside, typical of Lincolnshire, surrounds this windmill at Sibsey

MOST people know that Yorkshire is the largest county in England. But how many of us realise that the next largest is Lincolnshire? This county, which has an area of 2,663 square miles and a population of 504,678, lies on the east coast. It is divided into the 'Parts' of Lindsey, Kesteven, and Holland. Although much of it is very flat, limestone hills provide excellent grazing for sheep.

Early history

The first people in Lincolnshire we know about lived there in the New Stone Age. Their implements, boats, and burial mounds (long barrows) have been found there. These early people were followed by Celts, and for many hundreds of years shepherds counting their sheep used a special numbering (starting *yan*, *tan*, *tethera*, *pethera*, *pimp*) which is Celtic, and some of the numbers sound very like those used in Welsh today.

Lincoln Cathedral



Two of the most important Roman roads, the Fosse Way and Ermine Street, met at Lincoln. The Romans called the town *Lindum colonia*, and it was one of the four Roman 'colonies', or settlements for retired soldiers.

After the Romans left Britain, Lincolnshire was invaded by the Picts and the Scots, and later by Angles and Danes, who eventually settled in Lincolnshire. By the time of William the Conqueror the county was again very wealthy.

The Middle Ages

Domesday Book (written in 1086) has told us much about Lincolnshire, which was then the most densely populated county in England. Lincoln was one of the largest boroughs in the country, and in the next two centuries its prosperity increased. This was largely due to the wool trade – by 1130 there were over 200 weavers in Lincoln. Stamford, too, was famous for its cloth.

At the beginning of the 15th century several of the Lincolnshire towns were very wealthy. But during the century their prosperity declined. Grantham and Stamford were both damaged in the Wars of the Roses, and little cloth was made. New trade routes, and the silting up of the river Witham, drew trade away from the once flourishing port of Boston.

The Tudor period brought no improvement to conditions in Lincolnshire. A new type of landowner sprang up; some of the arable land was turned into pasture, and the men who had worked on it were unable to find employment. Bands of beggars terrorised the villagers, severe epidemics of plague broke out, and in 1571 an appalling flood took place.

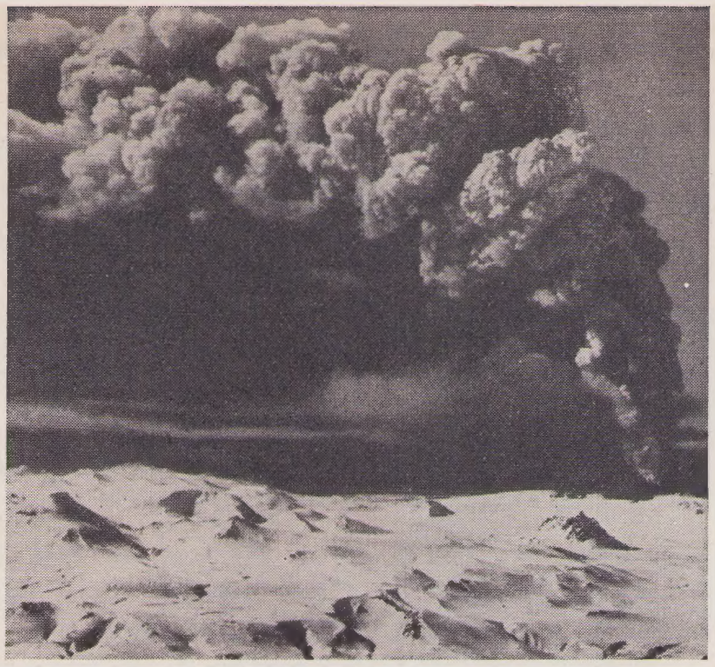
Improving the land

The first large-scale attempts to drain the fenland were made in 1626 by Cornelius Vermuyden, and by the end of the 18th century most of the marshy country was drained and the land enclosed. The breeds of sheep and cattle were improved, and a proper rotation of crops (see page 1387) was introduced. Clover, turnips, and other winter crops were grown.

Lincolnshire today is one of the most important agricultural areas in England, and wheat, barley, and oats are grown there. Other crops, like sugar beet and green vegetables, have led to processing and canning industries. Bulbs are grown around Spalding, and sheep and cattle are reared in great numbers.

Iron ore and coal are found in the north of the county, and Scunthorpe is an important centre of the iron and steel industry. There are large engineering works at Lincoln, Gainsborough, and Grantham. Grimsby, at the mouth of the river Humber, is one of the most important fishing ports in the world.

FOCUS on ICELAND



Belching lava, flames and smoke, Mount Hekla erupts. The Vikings thought that Iceland was the mouth of Hell.

A policeman in Reykjavik – his main job is controlling American cars.

ICELAND is just slightly larger than Ireland. It has a population of some 200,000, lies about 700 miles north-west of Scotland, and consists on the whole of a warm coastal belt surrounding a desert of mountain glaciers.

But these are glaciers with a difference, for there are constant volcanic eruptions which send molten lava spilling over the ice. Hot geysers spring from below the earth, spouting constant hot water up through the snowfields.

It is no wonder that the first Viking settlers, who went to Iceland from Scandinavia 1,000 years ago, believed that this fantastic country of contrasts was the mouth of Hell.

For hundreds of years the people of Iceland – a proud and independent race – went about their simple life; their economy was geared almost solely to the fishing industry.

And if it had not been for the Second World War, they might well have remained just as isolated today.

But in 1940 the military 'occupation' of the island by the British – only a short step ahead of the Germans – brought the realities of the outside world harshly home to the land of cod and herrings.

Then, in 1944, the Americans 'took over the defence' of Iceland. Today, they have a big military base at Keflavik which is one of the West's early warning stations against possible attack from the Soviet Union.

The occupiers, especially the Americans, have brought money in their wake, and in recent years the people of Iceland have embarked on something of a spending spree. In Reykjavik, the capital, new houses, office blocks, factories and sky-scrapers are going up – right in the middle of great oceans of mud. Roads come much later.

It is ironic that the Icelanders sell imported Russian oil to the Americans to help them run their base.

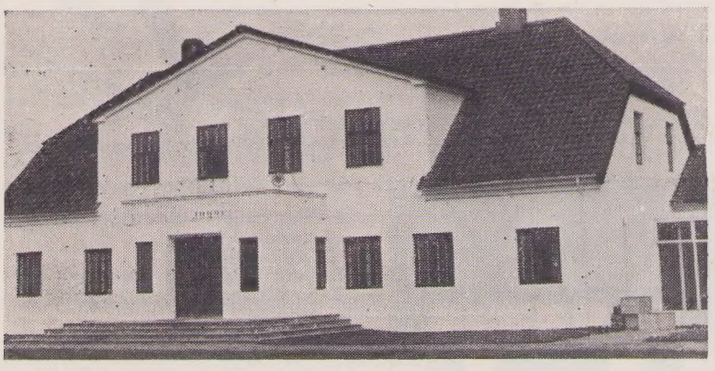
In spite of the fact that the Americans have been there for a number of years, the Icelanders do not like them. They say the Americans are a vulgar and uncultured people. But a more basic reason for the resentment of the Americans is a deep-rooted Icelandic fear of racial extinction.

Icelanders are a generous, hospitable people, but in the 4,000-odd Americans on the base they see the constant threat of their young women marrying U.S. servicemen. They do not want this to happen.

So the unfortunate U.S. servicemen at Keflavik are not allowed out after 10.30 at night; and only 200 of them are allowed to leave the base at any one time.

But despite official disapproval, American influence grows all the time. Coca-Cola signs sprout everywhere, and over 1,000 TV sets in Icelandic homes receive 'Gunsmoke' and 'Perry Mason', beamed from the American base.

It is pretty tough for the Americans in Iceland, and the Icelanders know it. But they say 'either they put up with our conditions – or they can pack up their base and go home . . .' and Icelanders are not easy people to argue with.



In parts of Iceland the people live in almost mediaeval simplicity – above are two Icelandic country women.

Reykjavik is a capital in miniature. (Left) The House of Parliament. On its right is the cathedral, which is smaller than many British parish churches. (Above left) The President's residence, about the size of a large suburban house.

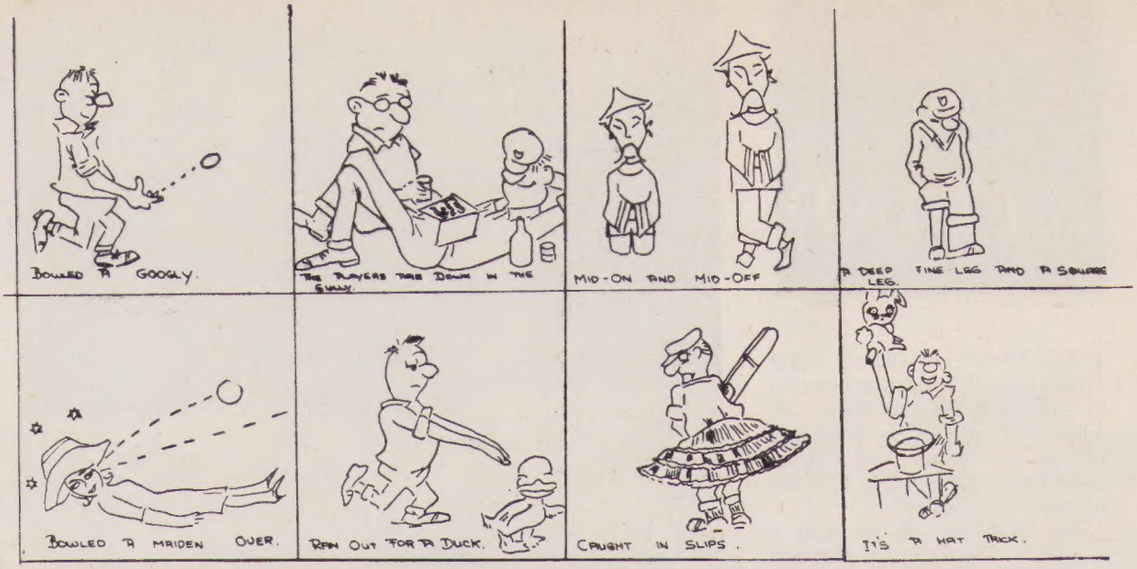
JOKE COMPETITION – OVERSEAS RESULTS

Australian winner

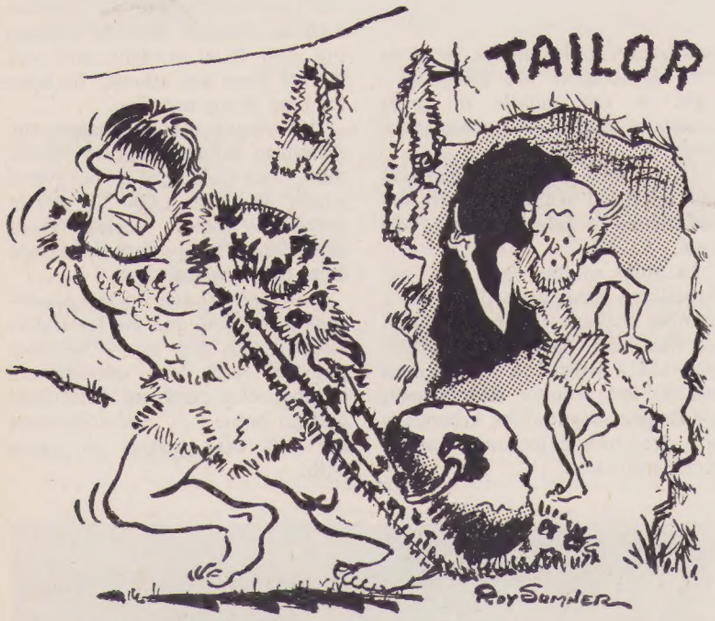
BY far the greatest number of entries for the Overseas section of the *Knowledge* Joke Competition came from Australia. Africa was also well represented, with Malta a close third, and the many jokes and cartoons received gave us a great deal of amusement.

The first prize of £3 goes to Helene Wiegard of Bendigo, Australia, for her own outstanding illustrations of the various terms used by cricket commentators during the recent Test Matches. Second prize, £2, is won by James Apps of Sliema, Malta. A third prize of £1 has been awarded to Vico Bandawe of Wellesly, S. Rhodesia. Both these jokes have been illustrated by our artist.

More jokes are published on this page and each of these has been awarded a copy of a *Knowledge* Classic.


BOWLED A GOOGLY.
THE PLAYERS TAKE DOWN IN THE SLIPS.
MID-ON AND MID-OFF
A DEEP FINE LEG AND A SQUARE LEG.
BOWLED A MAIDEN OVER.
RAN OUT FOR A DUCK.
CAUGHT IN SLIPS.
IT'S A HAT TRICK.

1st prize of £3: drawn by Helene Wiegard (age 15), 144 Gladstone Street, Bendigo, Victoria, Australia



'I'm sorry! I forgot to remove the price.'

2nd prize: James Apps (age 16), 8 Norfolk Street, Sliema, Malta G.C.

'You're both wrong – it was £4,000.'

3rd prize: Vico Bandawe (age 14), Junior Leader's Unit, P.O. Wellesly, Southern Rhodesia.

A Knowledge Classic

for each of the following jokes:

Years ago, a certain man was travelling on horseback from one outback town to another in northern South Australia. He had been told that the road forked about halfway, but he had forgotten which branch he was to take.

Before he came to the junction, however, he met an aged aborigine, riding in the opposite direction.

'When I get to two-fella road, which one go to Tilpa?' asked the man.

'Oh, that one easy now. They just put up new signboard longa that two-fella road,' replied the aborigine.

'That no good to me – I can't read,' said the man.

The aborigine grinned. 'Boss, you lucky,' he said. 'They haven't put any writin' on that fella board yet.'

Peter Macris (age 15),
112 Ormond Road, Elwood S.3,
Victoria, Australia.

An Englishman, newly arrived in Africa, was put in charge of a brickyard. So great was his surprise when he saw the natives carrying bricks on their bare heads that he decided to buy them a wheelbarrow to carry the bricks in. This he did. Some time later he went back to see how the work was progressing, only to find one African pushing another in the wheelbarrow, and the one in the wheelbarrow carrying a load of bricks on his head.

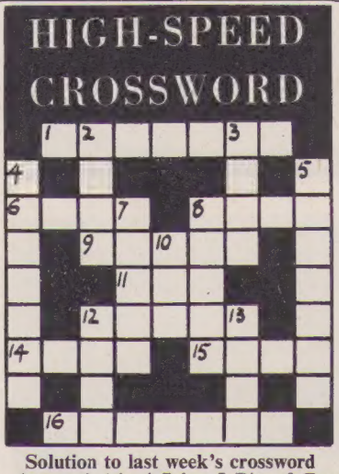
Frederick Bamutalira,
Box 1025, Kisubi, Uganda.

Teacher: 'Is the word trousers *singular or plural?'*

Pupil: 'Singular on top and plural below.'

Murray Kronfli (age 12),
P.O. Box 390,
Khartoum, Sudan.

HIGH-SPEED CROSSWORD



Solution to last week's crossword

ACROSS: 1, Ada; 4, Poker; 7, Ditto; 8, Dee; 9, Linen; 10, Associate; 13, Dream; 14, Pad; 16, Alice; 17, Resin; 18, New.

DOWN: 1, Add; 2, Diets; 3, Ate; 4, Policeman; 5, Kenya; 6, Rinse; 10, Adder; 11, Seeds; 12, Trace; 14, Pin; 15, Dew.

Clues Across

1. This subject includes physics and chemistry (7).
6. Just one (4).
8. Lord Rutherford first split it (4).
9. Small amphibious creatures with tails (5).
11. Encountered a short London railway? (3).
12. Weapon to throw (5).
14. Song for two (4).
15. Part in a play (4).
16. Another time-table subject (7).

Clues Down

2. First murderer (4).
3. Felines (4).
4. In football a player might be this right or left (7).
5. Deprive of air (7).
7. Try to mislead (5).
8. Essence of roses (5).
10. Very small (3).
12. Observed (4).
13. Sticks (sparing them spoils the child, says the proverb) (4).

Solution next week

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Vittorino founded a school which he called the *Casa Gioiosa* (Joyous House), and this name clearly indicated the new kind of education in which he believed. A free, joyous education, in which young people delighted, was the keynote.

Besides the intellectual education based upon a careful and extensive study of both Latin and Greek classical writings, Vittorino introduced into his school a series of gymnastic and sporting activities (running, jumping, fencing, swimming, hunting, and riding). He believed that children must be in good health and physically fit in order to do well in their studies. His pupils were also taught to be generous and loyal and to love one another.

The Reformation

The more liberal and humanistic outlook brought about by the Renaissance culminated in an upheaval, now known as the Reformation, which divided the Christian world and threw all learning into confusion. Education was to enter upon a new era which had a great impact upon future developments. In the end, it meant that schools and education were to be available to all, and that authority, over a wide area of Europe, was vested in the State rather than in the Church.

The work of educational reconstruction was begun by *Luther* (1483–1546). Ideally, he wanted free schools for all, regardless of status or sex. In the countries where Protestantism prevailed, schools opened in which Luther's principles were taught. His ideas, and those of *Erasmus* (1466–1536), were developed by other eminent scholars in many parts of western Europe.

The educational development of Protestantism demanded a similar effort on the part of the Roman Catholic Church. A religious order particularly devoted to the education of the young was that of the *Jesuits*, founded by a Spanish nobleman, *Ignatius Loyola* (1491–1556), in 1534. The Jesuits achieved enormous success, using the means employed by their religious opponents, and setting up a system of schools and universities to further their own particular aims. In the Catholic countries, by the end of the century, the Jesuits controlled the greater part of the education of the people.

Many other Roman Catholic religious orders concerned themselves with the education of children, while the first training school for teachers was set up in 1685 by the *Brothers of the Christian Schools*, a religious group founded by *Jean de la Salle*. About this time, Christian schools were established in England by the dissenting churches (the churches which do not accept the doctrines of the Established Church) and the Church of England for popular education.

Introduction of stages of education

In the 17th century some progressive educationists were worried by the way teaching was carried out in the schools, and gave much thought to the problem. They saw that a child's education and upbringing took little or no account of its needs according to its stage of development. Children were forced to deal with ideas beyond their mental abilities, and which were in no way connected with their natural interests and curiosity.

A great educationist who saw this clearly was *Johann Amos Comenius* (1592–1670). He stated that a good education must proceed by stages, and he wished to organise education in four progressive steps: firstly, nursery school for the period of infancy; secondly, elementary school for childhood; thirdly, latin school (equivalent to our secondary school

The courtyard of Bologna University, one of the three great universities of the Middle Ages

Much of the children's education at the Casa Gioiosa *took place in the open air*

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SUMMARY OF THE PROGRESS OF EDUCATIONAL DEVELOPMENT IN ENGLAND AND WALES

The Middle Ages. Schools attached to churches or subsidised by rich merchant patrons. Growth of Oxford and Cambridge and the college system.

18th century. Charity schools were sponsored by local churches, but education was for the poor 'according to their station'. Industrial development emphasised the need for more widespread education.

Early 19th century. The National Society (Church of England) and The British and Foreign Bible Society (undenominational) founded schools (fee paying) in many parts of England. These schools used the *monitorial system* – that is, older pupils acting as instructors under the direction of the teacher. The children of the wealthy attended expensive public schools, and there was no provision yet for the education of girls. London University founded in 1827.

Late 19th century. In 1870 the Elementary Education Act provided elementary education for all and made it compulsory up to the age of 10 years. State schools were provided, where the religious denominations had none, under locally elected School Boards. Many new universities were founded. The need for women and girls to be educated was realised.

20th century. 1902 *Education Act.* Local Education Authorities supplanted local School Boards. Education became compulsory for boys and girls up to the age of 14 years. Now poorer children could, by means of scholarships, benefit from secondary education and go to university. The need for technical education was becoming recognised about this time.

1926 *Hadow Report.* This report caused Junior Schools to be formed for children from 7 to 11 years, and Senior Schools for those from 11 to 14 years of age.

1944 *Education Act.* This laid the foundations of a new approach to education – secondary education for all. Thousands of new schools were built, and many universities were founded in the 1950's and early 1960's.

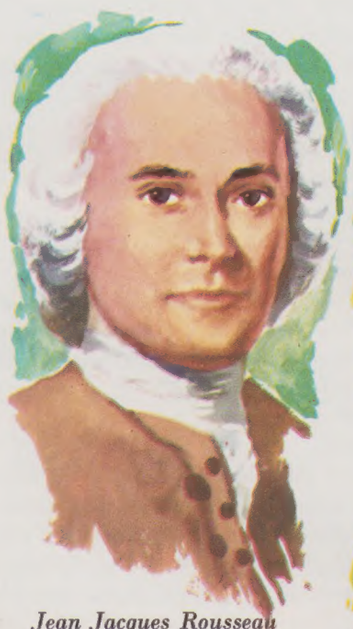
Johann Comenius (1592–1670), *shown on the right, proposed four types of schools: nursery schools* (*illustrated on the left*), *elementary schools, schools for learning Latin, and universities* (*on the right of the illustration*)

stage) for adolescence; fourthly, university for youth. Each of these schools was to prepare its pupils for the ideas which were to be taught in the next.

Two other great educators who influenced the schools of the future were: *Jean Jacques Rousseau* (1712–1768), a Frenchman, and *Johann Heinrich Pestalozzi* (1746–1827), a Swiss. Rousseau demonstrated in his book *Emile* that no form of education could be regarded as satisfactory which did not take into account the nature of the child. Pestalozzi, although agreeing in general with Rousseau, insisted that the child's natural impulses should be restrained and that some form of moral teaching should be imparted.

He thought that the kind of instruction in a good school should not be very different from that in a good home, although a wider range of interests are available in a school.

Many of his ideas are accepted today, and Pestalozzi international village schools, which were founded for orphan and refugee children, function today in Switzerland and England.



Jean Jacques Rousseau
(1712–1768)

Johann Heinrich Pestalozzi
(1746–1827)